THE HERPETOFAUNA OF THE CHINAMAN WELL AREA OF THE BIG DESERT, VICTORIA

A. J. COVENTRY

Herpetology Department, Museum of Victoria, 71 Victoria Crescent, Abbotsford, Victoria 3067

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A survey of the herpetofauna of the Chinaman Well area in the Victorian Mallee provided new data on the reproductive biology, ecological preferences and diets of many species. The area was sampled both pre and post extensive wild fires. Based on these data species such as *Ctenophorus pictus* and *Ctenotus brooksii iridis* benefit from fire, while elapid and typhlopid snakes are adversely effected. Distribution of several species across the study area indicate that the Victorian Mallee is a transitional zone between the southeastern Bassian and Eyrean zoogeographic regions.

BETWEEN August 1979 and December 1980, a survey of the herpetofauna of the Chinaman Well (35°52′42″S,141°39′52″E) area of the Big Desert in north western Victoria was undertaken. The flora of this area is comprised of areas of semi arid heath, interspersed with areas of mallee eucalypts with porcupine grass, *Triodia irritans*, set in fairly high scattered sand dune country. Because of the relative inaccessibility of the area, its fauna is poorly known. Rawlinson (1966) and Littlejohn (1966) have provided the only comprehensive lists of reptiles and amphibians respectively, recorded from the Victorian Mallee. Mather (1979) reported on the herpetofauna from within the then confines of the Wyperfeld National Park, while Baverstock (1979) listed these fauna from Billiatt Conservation Park, in the South Australian Murray mallee, and Menkorst (1982) listed and reported on the fauna from the White Springs area of the Big Desert. One of the aims of this work was to determine the species occurring in the Chinaman Well area and to study the ecology of this fauna. Since Rawlinson's and Littlejohn's 1966 lists, our understanding of the herpetofauna of this region has been greatly enhanced, with new species being added, and other species being separated into more than 1 taxon. Herpetological nomenclature used follows Cogger (1992), apart from *Phyllodactylus marmoratus*.

As a result of major wild fires in January 1981, sites 6 and 7 were totally devastated, site 4, immediately inside the perimeter of the fire boundary, suffered a 'cool' burn, and site 5 while not burnt, was adjacent to a totally devastated area, and separated from the perimeter of the fire by only about 10 m. These sites, together with sites 3 and 8 as controls, were re-established in September of that year in an attempt to assess the effects of the fires on the herpetofauna. This assessment was possibly affected by drought, combined with severe frosts in 1982.

MATERIALS AND METHODS

Pre fire 13 sites were sampled (Table 1), sites being selected because of the different composition of the flora, soils and topography, to ensure as wide

Site No.	Location
1	2 km N.E. of Chinaman Well, 35°52′46″S,141°39′51″E
2	0.6 N.N.E. of Chinaman Well, 35°52′42″S,141°39′49″E
3	1.3 km N. of Chinaman Well, 35°52′44″S,141°39′54″E
4	2 km N.N.W. of Chinaman Well, 35°51′56″S,141°39′37″E
5	2.75 km N.N.W. of Chinaman Well, 35°51′40″S,141°39′17″E
6	3.3 km N.N.W. of Chinaman Well, 35°51′27″S,141°38′57″E
7	5.1 km N.N.W. of Chinaman Well, 35°50′46″S,141°38′05″E
8	2 km N. of Chinaman Well, 35°52′22″S,141°40′31″E
9	2.8 km N.E. of Chinaman Well, 35°52′14″S,141°41′02″E
10	3 km N.E. of Chinaman Well, 35°52′09″S,141°41′11″E
11	4.7 km E.N.E. of Chinaman Well, 35°51′42″S,141°42′05″E
12	6.2 km E.N.E. of Chinaman Well, 35°51′52″S,141°43′06″E
13	6.6 km E.N.E. of Chinaman Well, 35°51′40″S,141°43′29″E

Table 1. Location of sites.

a range of habitats as possible (Table 2). Each site comprised 2 drift fences made from nylon fly wire mesh, 30 m long and 13 cm high. The fences ran approximately north–south and east–west, and had 10 pit-fall traps consisting of round metal containers that were 23 cm in diameter and 28 cm deep. Traps were closed between trips. A total of 14 trips were made, covering all seasons and climatic conditions, and during these trips, traps were checked and cleared each morning and evening. Co-ordinates of sites have been recorded using a Pyxis Global Positioning System Receiver IPS-360. During sampling daily maximum and minimum temperatures were recorded using a Zeal thermometer. Rainfall was also recorded, using a Marquis '600' rain-gauge measuring in mm.

Site	Vegetation Soil	Aspect	Topography	Overstorey	Understorey
1	Red clay		Large plain	*Eucalyptus calycogona* and *Eucalyptus dumosa*	*Dodonaea bursariifolia*, *Melaleuca uncinata* and *Melaleuca lanceolata*
2	Red clay and friable sands	Western slope	Low sand dune	*Eucalyptus behriana*, *E. dumosa*, *Acacia pycnantha* and *Myocarpon platycarpon*	*Acacia* spp., *Melaleuca* spp. and *Cassia* spp.
3	White sand		Interdune plain	*Eucalyptus foecunda* and *Eucalyptus incrassata*	*Callitris verrucosa*, *Leptospermum laevigatum*, *Hakea muellerana*, *Grevillea pterosperma*, *Casuarina muellerana* and *Triodia irritans*
4	White sand		Interdune plain	*E. incrassata* and *E. foecunda*	*Casuarina pusilla*, *C. verrucosa*, *L. laevigatum* and *T. irritans*
5	White sand	Top of dune	Low dune	*E. incrassata* and *E. foecunda*	*M. uncinata*, *Baeckea behrii*, *Phebalium bullatum* and *T. irritans*
6	White sand	Top of dune	Large dune	*E. incrassata*	*M. uncinata*, *B. behrii*, *P. bullatum*, *Hibbertia stricta* and *Lasiopetalum bauerii*
7	White sand	Top of dune	Large dune	*E. incrassata*	*M. uncinata*, *B. bauerii*, *P. bullatum*, *Laiopetalum behrii*, *H. muellerana*, *Acacia calamifolia*, *Baeckia crassifolia* and *Hibbertia* spp.
8	White sand		Interdune plain	*E. incrassata* and *E. foecunda*	*C. pusilla*, *L. laevigatum*, *H. muellerana*, *Grevillea pterosperma*, *Acacia spinescens*, *Lepidosperma carphoides* and *T. irritans*
9	White sand on limestone		Interdune plain	*E. foecunda*	*C. pusilla*, *T. irritans*, *B. crassifolia* and *Callitrix tetragona*
10	White sand	South eastern slope	Long low dune	*E. incrassata* and *E. foecunda*	*C. pusilla*, *H. muellerana*, *T. irritans*, *C. verrucosa*, *C. tetragona* and *H. stricta*
11	White sand	South western slope	Gently rising dune	*C. pusilla*, *L. laevigatum* and *T. irritans*	*H. muellerana*, *G. pterosperma*, *Lepidospermum myrsinoides*, *C. tetragona*, *B. crassifolia*, *Aotis ericoides* and *Leucopoga rufus*
12	White sand	North eastern slope	Large dune	*E. incrassata* and *E. foecunda*	*C. muellerana*, *L. laevigatum*, *Banksia ornata*, *C. verrucosa*, *H. muellerana* and *A. ericoides*
13	White sand	Southern slope	Large dune	*E. incrassata*	*B. ornata*, *Casuarina* spp., *Leptospermum* spp., *Calythrix* spp., *B. crassifolia*, *Phyllota pleurandroides* and *Styphelia exarrhena*

Table 2. Characteristics of sites.

RESULTS AND DISCUSSION

Pre fire 29 reptile and 2 amphibian species were recorded from the sites, representing the families Gekkonidae, Pygopodidae, Agamidae, Varanidae, Scincidae, Typhlopidae, Elapidae, and Myobatrachidae. Series of each species, where possible, were retained as specimens, and registered into the collections of the Museum of Victoria.

A total of 990 specimens were recorded from the study sites representing 11 648 pitfall day/nights, or 896 trap day/nights per site, plus some hand collecting of species, such as the larger pygopodids, which were not as prone as other species to being caught in, or were large enough to escape from the traps. The number of each species recorded from each site, and the months in which they were recorded are listed in Tables 3 and 4 respectively.

Post fire trapping was carried out on 13 occasions, involving 896 trap/day nights per site. These results are presented in tabular form (Tables 6–9).

NOTES ON SPECIES COLLECTED PRE FIRE

Order SQUAMATA

Family GEKKONIDAE Gray, 1825

Diplodactylus vittatus Gray, 1832

This species was trapped between the middle of August and the end of March, and came from varied habitats. Females were obtained between October and February. In October–November, both females had 2 oviducal eggs, the November

Species	Site number													Totals
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Diplodactylus vittatus	2	0	2	4	2	2	4	2	2	0	2	0	0	22
Lucasium damaeum	0	0	1	0	0	2	4	0	0	1	0	0	0	8
Phyllodactylus marmoratus	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Aprasia inaurita	2	0	2	0	0	4	5	0	0	0	1	1	0	15
Delma australis	2	4	1	4	5	1	0	0	0	1	3	5	0	26
Delma butleri	0	1	0	0	0	0	0	0	1	0	0	0	0	2
Lialis burtonis	0	1	1	2	0	1	0	0	0	0	0	0	0	5
Pygopus lepidopodus	0	0	1	0	2	0	1	1	0	1	1	0	0	7
Amphibolurus norrisi	8	1	1	4	9	4	1	1	5	2	1	4	1	42
Ctenophorus fordi	0	0	25	14	21	1	3	24	28	44	36	31	18	245
Ctenophorus pictus	1	3	5	9	5	11	8	3	3	10	7	11	3	79
Pogona vitticeps	1	0	0	3	0	1	1	2	0	1	3	0	1	13
Tympanocryptis l. lineata	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Varanus gouldii	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Varanus rosenbergi	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Ctenotus brooksi iridis	1	1	2	8	1	4	4	3	0	7	4	1	3	39
Ctenotus robustus	0	4	7	4	7	1	0	8	15	7	8	11	6	78
Ctenotus uber orientalis	10	6	1	4	4	5	5	7	1	2	2	7	1	55
Lerista bougainvillii	4	1	0	5	5	10	9	1	3	2	6	3	1	50
Menetia greyii	0	0	2	2	3	1	2	3	3	2	0	0	1	19
Morethia obscura	3	0	5	0	5	0	0	10	0	10	7	3	6	49
Tiliqua occipitalis	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Ramphotyphlops australis	0	0	1	0	1	0	0	0	0	1	0	0	0	3
Ramphotyphlops bituberculatus	1	13	1	0	0	2	0	2	3	1	0	0	0	23
Drysdalia mastersii	3	1	1	2	5	3	3	1	0	1	1	1	0	22
Echiopsis curta	0	1	0	0	0	1	0	6	1	0	0	0	0	9
Pseudonaja textilis	0	0	1	0	0	0	0	0	1	0	0	0	0	2
Suta nigriceps	0	0	6	2	0	1	2	0	3	1	0	0	1	16
Suta spectabilis	0	0	0	0	1	1	0	1	0	0	0	1	1	5
Liminodynastes d. dumerilii	7	8	1	1	1	1	1	2	1	0	2	2	0	27
Neobatrachus pictus	3	5	2	1	1	0	2	1	3	0	0	0	0	18
Totals	48	51	70	69	79	57	55	78	73	94	85	81	44	884

Table 3. Number of specimens of each species from each site.

specimen also had convoluted oviducts. Two females were collected in December, a juvenile without enlarged ovaries, suggesting that maturity is not attained in the first year. The other, an adult, contained 2 shelled eggs. The 3 specimens collected during January and February had no oviducal eggs present, the ovaries were only slightly enlarged, the oviducts were convoluted. Males were obtained each month between August and February. From August to December the testes were enlarged, the left testis length ranging from 6.6 to 7.8% of SVL. In January and February, the 2 males obtained had regressed testes of 3.1 and 4.6% SVL respectively, showing that males are in breeding condition from early spring until mid summer. Minimum temperatures recorded on successful trapping nights ranged from 6.5 to 23°C. Rain fell during the night of 26/27 September when the minimum temperature was 13°C, and 2 mm fell during the night of 22/23 October when the minimum temperature was 23°C. One specimen was trapped on each of these 2 nights. For details of diet, refer to Table 5.

Lucasium damaeum (Lucas & Frost, 1896)

This species was trapped between the beginning of November and the end of February. All came from sites with deep sand, and all but 1 were recorded from dunes. Indications were that breeding took place in late spring. One female obtained on November had enlarged ovaries, 1 in December had 2 large oviducal eggs, while the 1 collected in February had slightly enlarged ovaries

Species	Month												Totals
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Diplodactylus vittatus	2	4	1	0	0	0	0	1	2	4	6	2	22
Lucasium damaeum	0	3	0	0	0	0	0	0	0	0	4	1	8
Phyllodactylus marmoratus	0	0	0	0	0	0	0	0	0	0	1	0	1
Aprasia inaurita	1	0	0	0	0	0	0	0	0	11	1	2	15
Delma australis	0	9	2	0	0	0	0	3	1	3	4	4	26
Delma butleri	0	0	0	0	0	0	0	0	0	0	1	1	2
Lialis burtonis	0	1	0	0	0	0	0	1	0	0	2	1	5
Pygopus lepidopodus	1	2	0	0	0	0	0	1	0	0	1	2	7
Aniphibolurus norrisi	3	4	10	0	0	0	0	0	3	3	12	7	42
Ctenophorus fordi	20	47	31	0	0	0	0	0	21	42	23	61	245
Ctenophorus pictus	3	26	21	1	0	0	0	1	6	1	13	7	79
Pogona vitticeps	0	5	3	0	0	0	0	0	0	3	1	1	13
Tympanocryptis l. lineata	0	0	0	0	0	0	0	0	0	0	0	1	1
Varanus gouldii	0	1	0	0	0	0	0	0	0	0	0	0	1
Varanus rosenbergi	0	0	1	0	0	0	0	0	0	0	0	0	1
Ctenotus brooksi iridis	3	15	0	0	0	0	0	0	1	1	15	4	39
Ctenotus robustus	4	28	23	0	0	0	0	0	1	4	3	15	78
Ctenotus uber orientalis	3	25	6	0	0	0	0	0	4	7	4	6	55
Lerista bougainvillii	3	6	1	0	0	0	0	0	0	10	29	1	50
Menetia greyii	0	0	1	1	0	0	0	1	2	2	9	3	19
Morethia obscura	5	10	6	0	0	0	0	3	3	7	8	7	49
Tiliqua occipitalis	0	1	0	0	0	0	0	0	0	0	0	0	1
Ramphotyphlops australis	0	0	0	0	0	0	0	0	0	3	0	0	3
Ramphotyphlops bituberculatus	4	0	0	0	0	0	0	0	0	8	7	4	23
Drysdalia mastersii	1	1	7	1	1	0	0	0	5	2	0	4	22
Echiopsis curta	2	1	0	1	0	1	0	0	0	3	0	1	9
Pseudonaja textilis	0	0	0	0	0	0	0	0	0	2	0	0	2
Suta nigriceps	1	3	2	0	0	0	0	0	2	5	1	2	16
Suta spectabilis	0	0	1	0	0	0	0	0	1	1	1	1	5
Limnodynastes d. dumerilii	0	0	0	0	0	0	0	0	24	3	0	0	27
Neobatrachus pictus	0	0	0	0	0	0	0	4	14	0	0	0	18
Totals	56	192	116	4	1	1	0	15	90	125	146	136	884

Table 4. Number of each species recorded each month.

Prey item	Species						
	D. vittatus (12)	*D. australis* (19)	*C. fordi* (107)	*C. pictus* (67)	*P. vitticeps* (22)	*C. uber* (34)	*M. obscura* (62)
Arachnida							
Araneae	25	52.6	8.4	17.9	13.0	31.2	53.2
Scorpionida	16.7	0	0	0	0	0	0
Blattodea	75	42.1	0.9	3	9	21.9	12.9
Chilodopa	0	0	0	0	9	6.1	0
Coleoptera	0	10.5	49.5	23.9	81	21.9	19.7
Diplopoda	0	0	0	0	4	0	0
Diptera	0	0	8.4	3	0	0	11.7
Hemiptera	8.3	0	0	25.4	31	9.4	53.2
Hymenoptera							
Apoidea	0	0	23.8	7.5	0	6.3	6.5
Formicidae	33.3	0	97.2	98.5	86	40.6	11.7
Mutilidae	0	0	0	0	0	6.3	0
Gordiidae	0	0	0	0	0	0	1.6
Isoptera	0	0	0	0	0	21.9	1.6
Leafhoppers	0	0	0	1.5	0	0	0
Lepidoptera	0	10.5	7.5	9	18	18.8	12.9
Mollusca	0	0	0	0	0	3.1	1.6
Neuroptera	0	0	0.9	0	0	0	1.6
Odonata	0	0	0.9	0	0	0	0
Orthoptera	16.7	10.5	0	6	22	12.5	0
Plant material	0	0	0	0	4	15.6	0
Psyllidae	0	0	0	0	0	0	1.6
Thysanura	0	0	0	0	0	3.1	0
Vertebrata	0	0	0	0	9	0	0

Table 5. Stomach contents of *Diplodactylus vittatus*, *Delma australis*, *Ctenophorus fordi*, *Ctenophorus pictus*, *Pogona vitticeps*, *Ctenotus uber orientalis* and *Morethia obscura*. Numbers in the table show the percentage of specimens examined in which the prey item was present, the numbers in parentheses after the species indicate the number of stomachs examined.

and convoluted oviducts. In males, the 3 recorded in November had enlarged testes, the length of the left testis ranging between 10.5 and 14.1% of SVL, while the 2 collected in February had regressed testes, ranging from 5.2 and 5.3% of SVL. Minimum overnight temperatures recorded on nights when this species were trapped ranged from 4.0 to 23°C. No rainfall was recorded on successful trap nights. No specimens had food remains in the gut.

Phyllodactylus marmoratus (Gray, 1847)

This species was very uncommon within the study area, only 1 specimen was trapped, in November 1980 at site 2. Three specimens were collected by hand.

Species	Site number					
	3	4	5	6	7	8
Aprasia inaurita	1	0	0	0	0	0
Amphibolurus norrisi	0	1	0	0	0	0
Ctenophorus fordi	5	3	5	0	0	3
Ctenophorus pictus	1	0	1	0	0	0
Ctenotus brooksi iridis	0	1	2	1	0	4
Lerista bougainvillii	0	0	0	0	1	0
Menetia greyi	1	0	3	0	0	0
Morethia obscura	1	2	6	2	0	0
Limnodynastes d. dumerilii	0	0	0	2	2	1
Neobatrachus pictus	0	0	0	0	4	0

Table 6. Number of specimens of each species collected at each site during 1981 (180 trapping day/nights). One specimen of *Tiliqua occipitalis* was collected by hand from site 3.

Species	Site number					
	3	4	5	6	7	8
Diplodactylus vittatus	0	0	0	2	0	1
Lucasium damaeum	0	0	0	0	1	0
Aprasia inaurita	0	0	1	1	0	0
Delma australis	1	0	0	0	0	0
Delma butleri	0	0	2	0	0	0
Amphibolurus norrisi	0	0	2	1	0	0
Ctenophorus fordi	4	7	12	2	4	11
Ctenophorus pictus	3	5	0	8	14	6
Pogona vitticeps	0	0	0	1	0	0
Ctenotus brooksi iridis	3	4	0	4	2	6
Ctenotus robustus	2	1	2	2	0	1
Ctenotus uber orientalis	0	2	1	1	3	0
Lerista bougainvillii	0	0	0	1	3	0
Menetia greyii	0	1	0	0	0	0
Morethia obscura	3	5	1	0	1	3
Drysdalia mastersii	0	0	2	0	0	0
Echiopsis curta	0	0	0	0	0	1

Table 7. Number of specimens of each species collected at each site during 1982 (180 trapping day/nights).

Species	Site number					
	3	4	5	6	7	8
Diplodactylus vittatus	0	1	0	2	0	0
Lucasium damaeum	0	0	0	0	2	0
Delma australis	1	0	0	0	0	0
Delma butleri	0	0	0	0	0	1
Amphibolurus norrisi	0	0	1	1	2	0
Ctenophorus fordi	2	2	3	0	1	11
Ctenophorus pictus	2	7	2	2	7	0
Ctenotus brooksi iridis	0	2	0	1	0	6
Ctenotus robustus	2	1	2	0	0	0
Ctenotus uber orientalis	0	3	0	2	1	0
Lerista bougainvillii	0	2	0	2	2	0
Menetia greyii	0	0	1	0	0	0
Morethia obscura	0	1	0	0	0	0
Ramphotyphlops australis	0	0	0	1	0	0
Ramphotyphlops bituberculatus	0	0	0	0	0	1
Drysdalia mastersii	0	0	1	0	0	0
Echiopsis curta	0	0	1	0	0	0
Suta nigriceps	1	0	0	0	1	1
Limnodynastes d. dumerilii	1	0	1	0	0	0

Table 8. Number of specimens of each species collected at each site during 1983 (240 trapping day/nights).

Species	Site number					
	3	4	5	6	7	8
Diplodactylus vittatus	1	0	0	1	1	0
Lucasium damaeum	0	0	0	0	1	0
Aprasia inaurita	1	1	0	0	0	0
Amphibolurus norrisi	0	1	0	0	0	0
Ctenophorus fordi	6	4	2	1	1	9
Ctenophorus pictus	2	14	1	5	36	5
Pogona vitticeps	0	1	0	0	0	0
Ctenotus brooksi iridis	2	1	0	2	3	3
Ctenotus robustus	1	0	2	0	0	3
Ctenotus uber orientalis	0	0	1	0	1	0
Lerista bougainvillii	0	0	0	0	1	0
Menetia greyii	0	0	0	0	1	0
Morethia obscura	1	1	0	0	0	1
Ramphotyphlops australis	2	0	0	0	0	0
Ramphotyphlops bituberculatus	1	0	0	0	0	0
Echiopsis curta	0	1	0	0	0	0
Suta nigriceps	0	1	0	0	0	0
Neobatrachus pictus	0	1	0	0	0	0

Table 9. Number of specimens of each species collected at each site during 1984 (396 trapping day/nights).

Family PYGOPODIDAE, Gray, 1845

Aprasia inaurita Kluge, 1974

This species was only trapped between mid October and mid January. All were taken from traps in the evening, indicating they were diurnal, and all were trapped on days when the maximum temperature was at least 25°C. This finding contrasts with Cogger et al. (1983), who state that the species is nocturnal. Three of the specimens were female, the 2 obtained in October each having 2 oviducal eggs, while the 1 obtained in January had slightly enlarged ovaries, and convoluted oviducts. The males had testis length ranging from 5.8–7.9% of SVL in October, N=9, while in December they had regressed to 3.1–3.8% SVL, N=2. These data show an apparent peak of activity at the onset of warm weather, probably associated with males searching for breeding partners. Three specimens had food remains present, in each case consisting of small ant eggs. These specimens were collected from sites 6 and 7. Table 3 shows that 60% of the specimens collected came from these 2 sites. Both sites had numerous nests of ants of the genus *Aphaenogaster*.

Delma australis Kluge, 1974

Forty-nine specimens were examined from the area during the survey, 26 being taken in traps. The species was common, and readily obtained under *Triodia* or ground creepers. Based on testis length expressed as a percentage of SVL length, male breeding begins in late winter when the testis % of SVL ranged from 9.45 to 13.69,

M = 12.02, N = 5 during August; 10.29 to 12.81, M = 11.7, N = 5 in September, and 11.71 to 15.06, M = 14.11, N = 3 in October, and then declined in late spring and early summer when they ranged from 5.4 to 9.7, M = 8.16, N = 3 in November, from 4.4 to 7.69, M = 6.53, N = 5 in December and 4.8 to 7.33, M = 5.74, N = 4 in February. Females collected in August and September had several enlarged ovarian follicles present. In October and December respectively, 1 female was examined, and each had 1 egg present in each oviduct. Maturity appears to be attained at a SVL length of approximately 60 mm. The smallest reproductively active male was a September specimen with an SVL of 62.6 mm, with testis 11.54% of SVL. The largest immature female (SVL 59 mm) was taken in August and the smallest reproductively active female (SVL of 67 mm) a gravid specimen taken in December. Stomach contents were consistent with the invertebrates common in *Triodia* habitats (see Table 5).

Delma butleri Storr, 1987

Only 2 specimens were trapped (site 2 November 1980 and site 9 December 1980). An additional 10 specimens were collected by hand from sites 5, 3, and 2 from a few km SSE of Chinaman Well. Of the 2 specimens with food in their stomachs, 1 had remains of a lepidopteran, the other remains of a blattodid. Females had ovarian follicles present in August, and 1 specimen had 2 oviducal eggs in November. Patchell & Shine (1986) discuss aspects of the ecology of this species.

Lialis burtonis Gray, 1835

Both colour morphs of this species were obtained, 13 plain, comprising 6 males and 7 females, and 5 striped, 1 male and 4 females. All but 5 of these specimens were collected by hand near site 5. Despite the low sample size, there was some indication that females attain a greater SVL than males. Cogger et al. (1983) and Bustard (1970) reported that this species is lacertiphagous. Only 1 stomach examined contained food, a specimen of *Menetia greyii*.

Pygopus lepidopodus (Lacepede, 1804)

This species was widespread, and active from early spring through to late summer. No specimens examined had food in their stomachs.

Family VARANIDAE Hardwicke & Gray, 1827

Varanus rosenbergi Mertens, 1957

Only 1 specimen was trapped. A road kill in November 1980, 17 km WNW of Chinaman Well and a third specimen, a gravid female 0.6 km NW of Chinaman Well in December 1981 have also been obtained. This species appears to inhabit mallee heath in the interior of the Big Desert well isolated from agricultural areas.

Varanus gouldii (Gray, 1838)

Two specimens were recorded, a hatchling from site 13 and an adult male near site 11, both areas being relatively close to agricultural areas.

Family AGAMIDAE Gray, 1827

Amphibolurus norrisi Witten & Coventry, 1984

This species was collected at all sites. The 2 sites where it was most often recorded, 1 and 5, both had a comparatively high percentage of mallee eucalypts forming the upper canopy. It was often seen basking on low shrubs, or flattened *Triodia*. Reproductive and diet data for this species were listed by Witten & Coventry (1984).

Ctenophorus fordi (Storr, 1965)

This species has been studied and reported on by Cogger (1974, 1979). In January, February and March, hatchlings which had obtained an SVL in excess of 30 mm were still immature, and in those mature specimens which had survived, the testes had regressed. From September to December, almost all males in excess of 30 mm SVL were mature and ready for breeding. Those which were immature were possibly late hatchlings, which would survive to breed the following year. Females examined during October, November and early December each had 2 oviducal eggs present. Only 1 female was examined (October) which had survived after breeding the previous year. There was a bias of males towards females of 1—0.42. Those sites with little or no *Triodia* (1, 2, 6 and 7) produced only 4 specimens between them, demonstrating that it is a *Triodia* dependent species (Table 3). Diet analyses are presented in Table 5.

Ctenophorus pictus (Peters, 1866)

This species was widely distributed over the study area, being recorded from all sites. Sites, 6, 10 and

12, with traps on or down the sides of dunes accounted for 40% of the specimens trapped. Seventy per cent of specimens were recorded during the day, demonstrating that it is largely diurnal. Maximum temperatures when the lizard was collected ranged from 16°C to 45°C. Only 1 female was collected during August, this specimen had enlarged ovaries. Females had from 1–4, M = 2.6, N = 8 oviducal eggs present from October to December. By January, all females collected were hatchlings. Testes size appears to increase with the size of specimens, until a peak in late spring and early summer, with a decrease in January. The January male with a testis length of 4.4 mm had a SVL 58.4 mm, in comparison to a December specimen with testis length of 6.4 mm, and SVL of 58.1 mm, suggesting a reduction in reproductive activity. There was a bias of males towards females of 1—0.53. A minority of the population appear to survive to a second breeding season. Dietary analyses are presented in Table 5.

Pogona vitticeps (Ahl, 1926)

For comments on the relationships of this species see Witten & Coventry (1990). Table 5 summarises the diet. In males testes size reached a peak in late summer. Eggs were present in the oviducts of females until mid December. The maximum number of eggs recorded was 10, the minimum 7, M = 8; N = 7. Overall, the ratio of males: females was 1:2, with the ratio for February and March being 1:1, and for August to January, when the females were more active presumably to facilitate breeding, 1:4.5.

Tympanocryptis l. lineata Peters, 1863

Only 1 specimen of this species, a female, snout-vent length 45 mm, was recorded. It was trapped at site 5 during December 1979.

Family SCINCIDAE Gray, 1825

Ctenotus brooksi iridis Storr, 1981

This widely distributed species was found at all sites except 9. No particular habitat or soil type seemed preferred, although the hard soils of site 1 and the open habitat of site 2 produced only 1 specimen each. Most commonly recorded during November and February (Table 4). No analyses of stomach contents or gonads were carried out, as the specimens constitute the type series.

Ctenotus robustus Storr, 1970

The largest *Ctenotus* in the study area. It was widespread and common, although not recorded from sites 1 and 7. Most common at sites 9 and 12, in contast to *C. uber orientalis* which was most prevalent on site 1, and least common at sites 3 and 13 (Tables 3, 4). *C. robustus* appears to emerge slightly later than *C. uber orientalis*, with only 7% of specimens being recorded during September and October, and 22.5% during November and December, as against 22.3% and 11.1% respectively. Correspondingly, *C. robustus* appears more active later in the year with 29.6% of specimens being recorded in March; only 13.3% for *C. uber orientalis*. Female reproductive data was confined to 6 specimens considered to be mature. These ranged from 85.1–105.3 mm SVL. The 3 December specimens each had 6 oviducal eggs, while the 2 January and 1 February specimens had convoluted oviducts. Fifteen mature males were examined, the testes were enlarged during late spring and early summer, but had regressed by early autumn. Breeding males had broad testes when compared with non breeding specimens. Specimens do not breed until their second year, a 1 year old female collected in December having an SVL of 56.7 mm and a 1 year old male, also collected in December having an SVL of 71.2 mm. The smallest hatchling collected had an SVL of 34.7 mm. Brown (1983) provided diet analyses for specimens from this survey.

Ctenotus uber orientalis Storr, 1971

This species although common and widespread, preferred the harder, more reddish soils, such as site 1 where most recordings occurred. The largest specimen recorded was a female taken in December, with an SVL of 71.4 mm. None of the adult females sampled (2 in September and 3 in December) had oviducal eggs present although all had convoluted oviducts. The smallest breeding female had an SVL of 57.2 mm. In males testes were enlarged by September and had started to regress by January. This suggests that this species breeds slightly earlier in the season than *C. robustus*. The smallest adult male had an SVL of 58.5 mm. The smallest hatchling collected had an SVL of 24.7 mm. For details of diet see Table 5.

Lerista bougainvillii (Gray, 1839)

This species was common and widespread, although showing an apparent preference for

sandy substrates. Sites such as 6 and 7 were most preferred. Qualls et al. (1995) discussed the evolution of viviparity within this species. Specimens from the study area were oviparous. Cogger et al. (1983) list this species as being an arthropod feeder.

Menetia greyii Gray, 1845

The smallest member of the skink family in the study area. The smallest specimen examined had an SVL of 19.8 mm, while the largest specimen had an SVL of 33.1 mm, with females being slightly larger size than males, ranging from 20.8 mm to 33.1 mm SVL, M = 27.6, N = 13, and males ranging from 19.8 mm to 29.9 mm SVL, M = 26.1, N = 17. The species was widespread, most specimens trapped being recorded during November. Although recorded from other areas where *Triodia* is absent, it is interesting to note that within the study area, it was not, or infrequently trapped where *Triodia* was absent or sparse. Mating appears to take place during late spring–early summer, females laying 2 eggs in mid summer. One September female had enlarged ovarian follicles present and convoluted oviducts, and 2 specimens collected in November each had 1 oviducal egg present in each oviduct, which were convoluted. In the males the testes are enlarged during September and October, when they are between 14 and 18.5% of SVL, M = 15.3%, N = 4 and start regressing during November and December, when they drop back to between 11.7 and 15.5% of SVL M = 12.9%, N = 10.

Morethia obscura Storr, 1972

A common and widespread species which is active throughout the year excepting winter. Females lay 2–3 eggs in early to mid summer. By the end of January, egg laying had ceased. By August the ovaries are beginning to become enlarged, and by October oviducal eggs are present. In males the testes attain their greatest size in August, and by December are starting to recede. For details of diet see Table 5.

Tiliqua occipitalis (Peters, 1863)

Only 1 specimen was trapped, a juvenile male, recorded in February from site 11.

Trachydosaurus rugosus Gray, 1825

Although observed and widespread in the area, this species was not taken in pitfall traps.

Family TYPHLOPIDAE Jan, 1863

Ramphotyphlops australis (Gray, 1845)

This species was only collected on the night of 22/23 October 1980, with individual specimens being trapped on sites 3, 5 and 10. This night was warm and humid, with a minimum temperature of 20°C. 2 mm of rain was also recorded. All specimens were males, ranging in SVL from 291 mm, to 261 mm. Testis length ranged from 3.5 to 4.8% of SVL length. All specimens lacked stomach contents.

Ramphotyphlops bituberculatus (Peters, 1863)

Most commonly recorded from site 2. All sites where this species was collected excepting site 1, had sandy substrates.

Family ELAPIDAE Boie, 1827

Drysdalia mastersii (Krefft, 1866)

The most common elapid trapped or observed during the survey, and one of the 2 diurnal species. It was widespread, being recorded from all sites. It was also active for a consistently greater period of the year than other species, being trapped as late as May, and observed as early as August. Stomach contents consisted of skinks, 4 specimens had remains of *Morethia obscura*, 2 of *Lerista bougainvillii*, 1 a juvenile *Ctenotus robustus*, and 2 unidentifiable skinks and ant remains. It is assumed that the ant remains were from the stomachs of prey items. In males the testes become enlarged in January, and remain enlarged until the beginning of winter, regressing by spring. Although the current sample size is small it would suggest that the species mate soon after the females give birth, and in the light of Shine's findings (1981), would suggest that the females store sperm over winter. Shine (1977a) records that in some other live bearing elapids mating takes place in autumn soon after parturition, and also in spring. For further information of the ecology of this species see Shine (1981).

Echiopsis curta (Schlegel, 1837)

A nocturnal species, most commonly trapped on site 8. Of the 3 the females, 1, collected in October with an SVL of 320 mm, had 7 oviducal embyros. The other females were both collected in January. One was immature with an SVL of 178 mm, the other an adult with an SVL of

331 mm. The largest specimen collected was a male, SVL 331 mm. Only 3 specimens had food items present, and these consisted of a *Ctenophorus fordi*, a *Morethia obscura* and a *Ninguai* sp. (Coventry & Dixon 1984).

Pseudonaja textilis (Dum. Bib. & Dum. 1854)

The largest and only oviparous elapid in the area was only trapped twice, once at site 3 and once at site 9, both times during October. The specimen from site 3 was a juvenile, the specimen from site 9 just over 1 m in length. When collected, this specimen was preying on a trapped *Amphibolurus norrisi*. Several other specimens were observed both in the study area, and on the surrounding farm lands.

Suta nigriceps (Gunther, 1863)

This nocturnal species was only located by pitfall trapping. On previous occasions the author has collected desert heath specimens from under iron, and also under a rock. Of the 16 specimens, 7 had food remains in the gut. All food remains were of lizards. All specimens were males, ranging in size from 153–369 mm SVL. In adults, testes size ranged from 1–4.4% of SVL length, with no noticeable trends towards being enlarged at any particular season (Jan. 3.7; Feb. 3.2; Mar. 2.3; Oct. 2.5, N = 2; Nov. 3.0; Dec. 1.0, N = 1. It is expected that this species would mate in autumn.

Suta spectabilis (Krefft, 1869)

This strictly nocturnal species was also only located by trapping. It is presumed to be widespread throughout the area, but less common than *Suta nigriceps*. The smallest specimen a female had an SVL of 141 mm. The other 4 specimens, males, ranged from SVL 233 mm to 261 mm. The September and October specimens had testes lengths 2.7 and 2.3% of SVL respectively while the March specimen had testes length of 4.1% of SVL, suggesting that breeding takes place in late summer and early autumn, with the young being born in spring or early summer. This would concur with the findings of Shine (1977b). Only 1 of the specimens had any food in the gut, the tail of a scincid lizard.

Order SALIENTIA

Family MYOBATRACHIDAE Schlegel, 1850

Only 2 species of amphibians, *Limnodynastes dumerilii dumerilii* Peters, 1863, and *Neobatrachus pictus* Peters, 1863, were recorded, although other species (e.g. *Limnodynastes tasmaniensis* Gunther, 1858; *Neobatrachus sudelli* (Lamb, 1911) and *Pseudophryne bibroni* Gunther, 1858) have been recorded from adjacent areas (Brook 1982). Both species are burrowers, and proved extremely common in suitable conditions. In the September sample, when over 20 mm of rain fell, a total of 39 specimens were recorded. In October 1979, a dry month, only *L. d. dumerilii* was recorded and in August 1980, when 6.7 mm of rain fell, only *N. pictus* were recorded. Eggs of this species were laid in temporary ponds, where wastage was extremely high. No analyses were made of gut contents or gonads.

DISCUSSION OF VICTORIAN SEMI-ARID HERPETOFAUNA

Abundance

Pre fire a total of 36 elapid and 26 typhlopid snakes were trapped while post fire only 9 elapid, 2 of which were recorded from the unburnt control sites, and 5 typhlopid specimens, were recorded. The first elapid was not recorded until February–March 1982, and only 3 were recorded prior to September 1983, the first typhlopid recorded in November–December 1983. This suggests that snakes have little protection from wild fires, and/or that those that do survive the fires are easy victims of predators. There was also a marked difference between the comparative numbers of the 2 species *Ctenophorus fordi* and *Ctenophorus pictus* pre and post fire. This is demonstrated in Table 10, where the percentage of *C. pictus* recorded was 31.8 pre and 54.6 post fire. If the results obtained from sites 3 and 8 post fire are ignored, i.e. the unburnt control sites, the percentage of *C. pictus* recorded was 46.6 pre fire and 67.5 post fire. In the figures for site 5 the percentages were 57.1 pre fire and 77.5 post fire. While these figures tend to demonstrate that sites 4, 6 and 7 were more attractive to *C. pictus* pre fire, they do demonstrate that *C. pictus* appears to prefer the more open areas provided in habitats with little or no *Triodia*. At site 7, the most open site pre fire, and the most heavily burnt, the percentage of *Ctenophorus* recorded which were *C. pictus* constituted 72.7 pre and 95.1 post fire. Also, Tables 6 and 7 demonstrate that in the immediate season post fire, numbers of both species were well maintained, but that *C. fordi* numbers then began to drop off, before recovering, presumably attributable to the

Species	Site number												Totals	
	3		4		5		6		7		8			
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Diplodactylus vittatus	2	1	4	3	2	1	2	5	4	1	2	4	16	15
Lucasium damaeus	1	0	0	0	0	0	2	0	4	4	0	0	7	4
Aprasia inaurita	2	2	0	1	0	1	4	1	5	1	0	0	11	6
Delma australis	1	2	4	0	5	1	1	0	0	1	0	2	11	4
Delma butleri	3	0	0	0	4	1	0	0	0	0	0	0	7	1
Lialis burtonis	1	1	2	0	0	0	0	0	0	0	0	0	4	1
Pygopus lepidopodus	1	0	0	0	2	0	0	0	1	0	0	0	5	0
Amphibolurus norrisi	1	1	4	1	9	4	4	2	1	1	1	1	20	11
Ctenophorus fordi	25	20	14	17	21	26	1	4	3	3	24	34	88	104
Ctenophorus pictus	5	8	9	27	5	4	11	15	8	58	3	13	41	125
Pogona vitticeps	0	0	3	1	1	0	1	1	1	1	2	0	8	3
Tympanocryptis l. lineata	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Varanus rosenbergi	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Ctenotus brooksi iridis	2	6	8	8	1	4	4	8	4	22	3	1	22	49
Ctenotus robustus	7	7	4	3	7	6	1	2	0	0	8	4	27	22
Ctenotus uber orientalis	1	2	4	7	4	5	5	4	5	7	7	1	26	26
Lerista bougainvillii	0	0	5	2	5	0	10	4	9	7	1	0	30	13
Menetia greyii	2	1	2	1	3	2	1	0	2	1	3	2	13	7
Morethia obscura	5	5	0	9	5	9	0	4	0	4	10	4	20	35
Ramphotyphlops australis	1	2	0	0	1	0	0	1	0	0	0	0	2	3
Ramphotyphlops bituberculatus	1	1	0	0	0	0	2	0	0	0	2	1	5	2
Drysdalia mastersii	1	0	2	0	5	3	3	0	3	0	1	0	15	3
Echiopsis curta	0	0	0	0	0	0	1	0	0	0	6	0	7	0
Pseudonaja textilis	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Suta nigriceps	6	1	2	1	0	0	1	0	2	1	0	1	11	4
Suta spectabilis	0	0	0	0	1	0	2	0	0	0	1	0	3	0
Limnodynastes d. dumerilii	1	1	1	0	1	1	2	2	1	2	12	1	7	7
Neobatrachus pictus	2	0	1	1	1	0	0	0	2	4	1	0	7	5

Table 10. Comparison of total catches at each site pre and post fire.

paucity of *Triodia*. On the other hand, *C. pictus* numbers showed rapid increase with the additional open areas available to them. Percentage wise, 44.9% of *C. fordi* recorded were pre fire, compared with only 24.6% of *C. pictus*. In the case of the 3 *Ctenotus* species, numbers of both *Ctenotus robustus* and *Ctenotus uber orientalis* remained fairly static, whereas *Ctenotus brooksi iridis* appear to prefer the more open areas post fire, with only 29.3% of the total catch being pre fire.

Zoogeography

Spencer (1896) divided Australia into 3 main zoogeographic regions, Torressian (monsoonal), Eyrean (arid and semi-arid) and Bassian (higher rainfall SE and SW of Australia). Other workers e.g. Littlejohn (1971) have basically agreed with Spencer's concept. Rawlinson (1971) divided Victoria into 2 main regions (Eyrean and Bassian), which he further subdivided. Thus his Eyrean region included 'true Eyrean' and 'Murray River corridor', and his Bassian 'warm temperate', 'cool temperate' and 'cold temperate'. Those areas under discussion fall into his 'true Eyrean' zone.

Some eyrean, species such as *C. pictus* occur widely and are very common as far south as the southern edge of the Little Desert, others such as *C. fordi* reach their southern limit in the south of the Big Desert. In the south, *A. inaurita* is replaced by *Aprasia striolata*, while *Lampropholis delicata* does not occur north of the Little Desert. South of Chinaman Well towards Netherby, *Pogona barbata*, a Bassian species, replaces the Eyrean *P. vitticeps*. True Eyrean species such as *Pseudonaja nuchalis*, *Rhynchoedura ornata* and *Heteronotia binoei* are found only in the northern areas, suggesting that the Victorian Mallee is a transitional zone between the southeastern Bassian and Eyrean zoogeographic regions.

While amphibians can be divided into zoogeographic regions, rivers and lakes cause artificial overlaps. The Murray River corridor and the lake systems thus affect this Victorian Mallee fauna.

Diversity

Lizard species diversity within the Big Desert areas agree with the findings of Pianka (1986), who found that the Great Victorian Desert in Western Australia had both a high number of species and high species population densities. The numerous micro-environments in desert heath provide ample opportunity for species specialisation, and habitat partitioning by the lizard fauna. Skinks were the most diverse family, with the *Morethia boulengeri* complex represented within the mallee by 3 species, each with its own habitat niche. Snakes on the other hand were poorly represented, with 71% of the species being nocturnal, of these 80% were fossorial. The presence of only 2 species of diurnal elapids was possibly due to the presence of large potential predators. This theory is supported by the fact that only snakes, over 1 metre in length, were observed basking or moving.

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